

8. REGULATIONS AND ADVISORIES

Because of its potential to cause adverse health effects in exposed people, a number of regulations and guidelines have been established for selenium by various national and state agencies. These values are summarized in Table 8-1.

The NRC RDAs (NAS 2000) are as follows:

Men: 0.055 mg/day

Women: 0.055 mg/day

Pregnant women: 0.060 mg/day

Lactating women: 0.070 mg/day

Infants (0–6 months): 0.015 mg/day

Infants (7–12 months): 0.020 mg/day

Children (1–3 years): 0.020 mg/day

Children (4–8 years): 0.030 mg/day

Children (9–18 years): 0.040 mg/day

A chronic oral MRL of 0.005 mg/kg/day has been derived for selenium based on a NOAEL of 0.015 mg/kg/day for dermal effects identified by Yang and Zhou (1994). The NOAEL was divided by an uncertainty factor of three to account for sensitive individuals. The EPA (EPA 1993) has derived a chronic oral reference dose (RfD) of 0.005 mg/kg/day for selenium based on studies by Yang et al. (1989a, 1989b). This value is equal to the average daily intake of selenium in the diet (0.853 mg/day) considered adequate and safe. The RfD was derived assuming an average body weight of 55 kg. It was based on a NOAEL of 0.015 mg selenium/kg/day. An uncertainty factor of 10 was not applied since similar NOAELs were identified in two human populations exposed to selenium levels in excess of the RDA throughout a lifetime without apparent clinical signs of selenosis. An uncertainty factor of 3 was applied to the NOAEL to account for sensitive individuals.

8. REGULATIONS AND ADVISORIES

Table 8-1. Regulations and Guidelines Applicable to Selenium

Agency	Description	Information	References
<u>INTERNATIONAL</u>			
Guidelines:			
IARC	Carcinogenicity classification	Group 3 ^a	IARC 2001
WHO	Guideline for drinking water	0.01 mg/L	WHO 2001
	Recommended daily intake—adults	0.9 µg/kg body weight	
<u>NATIONAL</u>			
Regulations and Guidelines:			
a. Air			
ACGIH	TLV (8-hour TWA)		ACGIH 2000
	Selenium and compounds	0.2 mg/m ³	
	Selenium hexafluoride	0.16 mg/m ³	
EPA	Hazard rank under Section 112(g) of the Clean Air Act Amendments	42 out of 1–100, with 100 being the most toxic	EPA 2001a
	Reference air concentration	3.0 µg/m ³	EPA 2001b 40CFR 266, Appendix IV
NIOSH	REL (TWA)		NIOSH 2001
	Selenium and compounds, except selenium hexafluoride	0.2 mg/m ³	
	IDLH		
	Selenium and compounds	1.0 mg/m ³	
OSHA	General industry PEL (TWA)		OSHA 2001 29CFR1910.1000, Table Z
	Selenium and compounds	0.2 mg/m ³	
	Selenium hexafluoride	0.4 mg/m ³	
	Hydrogen selenide	0.2 mg/m ³	
	Construction industry PEL (TWA)		OSHA 2001
	Selenium and compounds	0.2 mg/m ³	
	Selenium hexafluoride	0.16 mg/m ³	
b. Water			
EPA	MCLG	0.05 mg/L	EPA 2001c 40CFR141.51
	MCL	0.05 mg/L	EPA 2001d 40CFR141.62

8. REGULATIONS AND ADVISORIES

Table 8-1. Regulations and Guidelines Applicable to Selenium (*continued*)

Agency	Description	Information	References
<u>NATIONAL</u> (<i>cont.</i>)			
EPA	DWEL	0.2 mg/L	EPA 2000
	Health advisory—lifetime	0.05 mg/L	
	Groundwater monitoring (PQL)	750 µg/L	EPA 2001e 40CFR264, Appendix IX
	Groundwater monitoring— concentration limits	0.01 mg/L	EPA 2001f 40CFR264.94
	Water quality standards		EPA 2001g 40CFR131.36
	Freshwater		
	Maximum concentration	20 µg/L	
	Continuous concentration	5.0 µg/L	
	Saltwater		
	Maximum concentration	290 µg/L	
	Continuous concentration	71 µg/L	
c. Food			
FDA	Approved use of selenium as a food additive in animal feeds—added to feed for chickens, swine, turkeys, sheep, cattle, and ducks	#0.3 ppm	FDA 2001a 21CFR573.920
	Bottled water—allowable level	0.05 mg/L	FDA 2001b 21CFR165.110
	RDA (mg/day)		NAS 2000
	Men	0.055	
	Women	0.055	
	Pregnant women	0.060	
	Lactating women	0.070	
	Infants (0–6 months)	0.015	
	Infants (7–12 months)	0.020	
	Children (1–3 years)	0.020	
	Children (4–8 years)	0.030	
	Children (9–18 years)	0.040	
d. Other			
EPA	Carcinogenicity classification		IRIS 2001
	Selenium and compounds	Group D ^b	
	Selenium sulfide	Group B2 ^c	
	Designation of hazardous substances		EPA 2001h 40CFR116.4
	Selenium oxide		
	Sodium selenite		

8. REGULATIONS AND ADVISORIES

Table 8-1. Regulations and Guidelines Applicable to Selenium (*continued*)

Agency	Description	Information	References
<u>NATIONAL</u> (<i>cont.</i>)			
EPA	Determination of reportable quantities		EPA 2001i 40CFR117.3
	Selenium oxide	10 pounds	
	Sodium selenite	100 pounds	
	Extremely hazardous substance		EPA 2001j 40CFR355, Appendix B
	Reportable quantity		
	Hydrogen selenide	10 pounds	
	Selenious acid	10 pounds	
	Selenium oxychloride	500 pounds	
	Threshold planning quantity		
	Hydrogen selenide	10 pounds	
	Selenious acid	1,000/10,000 pounds	
	Selenium oxychloride	500 pounds	
	Identification and listing of hazardous waste		EPA 2001k 40CFR261, Appendix VIII
	Selenium		
	Selenium and compounds		
	Selenium dioxide		
	Selenium sulfide		
	Selenium tetrakis, (dimethyl-dithiocarbamate)		
	Selenious acid		
	Selenourea		
	Thallium selenite		
EPA	Protection standards at inactive uranium processing sites—listed constituents		EPA 2001l 40CFR192, Appendix I
	Selenium and compounds		
	Selenium dioxide		
	Selenium sulfide		
	Recommended daily allowances		EPA 2001m
	Selenium and compounds		
	Men	0.7x10 ⁻¹ mg/kg/day	
	Women	0.55x10 ⁻¹ mg/kg/day	
	Infants	8.7x10 ⁻⁴ mg/kg/day	
	Reportable quantity		EPA 2001n 40CFR302.4, Appendix A
	Selenium and compounds	1 pound	
	Selenium dioxide	1,000 pounds	
	Selenium sulfide	1 pound	
	Selenious acid	1 pound	
	Selenourea	1 pound	
	Sodium selenite	1,000 pounds	
	Thallium selenite	1 pound	

8. REGULATIONS AND ADVISORIES

Table 8-1. Regulations and Guidelines Applicable to Selenium (*continued*)

Agency	Description	Information	References
<u>NATIONAL</u> (<i>cont.</i>)			
EPA	Reportable quantity Selenium oxide	10 pounds	EPA 2001o 40CFR117.3
	Sewer sludge—disposal or use standards		EPA 2001p 40CFR503.13
	Ceiling concentration	100 mg/kg	
	Cumulative pollutant loading rate	100 kg/hectare	
	Pollutant concentration ^d	100 mg/kg	
	Annual pollutant loading rate	5.0 kg/hectare per 365-day period	
	Toxic chemical release reporting; Community Right-to-Know —effective date	01/01/87	EPA 2001q 40CFR372.65
<u>STATE</u>			
Regulations and Guidelines:			
a. Air			
Hawaii	HAP		BNA 2001
Illinois	Toxic air contaminant		BNA 2001
Kansas	HAP		BNA 2001
Kentucky	HAP		BNA 2001
Maryland	Toxic air pollutant Selenium sulfide		BNA 2001
Minnesota	HAP threshold—de minimis level		BNA 2001
	Selenium compounds	0.1 ton/year	
	Selenium sulfide	0.1 ton/year	
Nebraska	HAP—effective date	12/15/98	BNA 2001
New Hampshire	Regulated toxic air pollutant		BNA 2001
New Mexico	Toxic air pollutant		BNA 2001
	OEL	0.2 mg/m ³	
	Emissions	0.0133 mg/m ³	
New York	HAP—selenium compounds		BNA 2001
Rhode Island	HAP		BNA 2001
South Carolina	Toxic air emissions—maximum allowable concentration		BNA 2001
	Selenium compounds	1 µg/m ³	

8. REGULATIONS AND ADVISORIES

Table 8-1. Regulations and Guidelines Applicable to Selenium (*continued*)

Agency	Description	Information	References
<u>STATE (cont.)</u>			
Vermont	Hazardous ambient air standards Annual average Action level	4.80 µg/m ³ 0.40 pounds/8-hours	BNA 2001
Washington	HAP—threshold levels Selenium and compounds Selenium hexafluoride Selenium sulfides	0.5 tons/year 0.5 tons/year 0.5 tons/year	BNA 2001
b. Water			
Alabama	Aquatic life criteria Freshwater Acute Chronic Marine Acute Chronic MCL Primary drinking water standard	20 µg/L 5.0 µg/L 300 µg/L 71 µg/L 0.05 mg/L 0.01 mg/L	BNA 2001 BNA 2001
Alaska	Groundwater cleanup level MCL	0.05 mg/L 0.05 mg/L	BNA 2001 BNA 2001
Arizona	Aquifer water quality standards Drinking water guideline MCL Water quality standards Conversion factor ^e for saltwater—acute criteria Conversion factor ^e for saltwater—chronic criteria	0.05 mg/L 45 µg/L 0.05 mg/L 0.998 0.998	BNA 2001 HSDB 2001 BNA 2001 EPA 2001r 40CFR131.38
Colorado	Groundwater protection—MCL MCL Primary drinking water standard	0.01 mg/L 0.05 mg/L 0.01 mg/L	BNA 2001 BNA 2001 BNA 2001
Connecticut	MCL	0.05 mg/L	BNA 2001
Delaware	Groundwater protection—MCL Primary drinking water standard	0.01 mg/L 0.01 mg/L	BNA 2001 BNA 2001
Florida	MCL	0.05 mg/L	BNA 2001
Georgia	MCL	0.05 mg/L	BNA 2001
Hawaii	MCL	0.05 mg/L	BNA 2001

8. REGULATIONS AND ADVISORIES

Table 8-1. Regulations and Guidelines Applicable to Selenium (*continued*)

Agency	Description	Information	References
STATE (<i>cont.</i>)			
Hawaii	Water quality criteria applicable to all waters		BNA 2001
	Freshwater		
	Acute	20 µg/L	
	Chronic	5.0 µg/L	
	Saltwater		
	Acute	300 µg/L	
	Chronic	71 µg/L	
Illinois	Concentration shall not be exceeded in water	1.0 mg/L	BNA 2001
	Groundwater quality standard	0.01 mg/L	BNA 2001
	MCL	0.05 mg/L	BNA 2001
Indiana	MCLG	0.05 mg/L	BNA 2001
	MCL	0.05 mg/L	
Iowa	MCL	0.05 mg/L	BNA 2001
Kansas	Surface water quality standard		BNA 2001
	Aquatic life		
	Acute	20 µg/L	
	Chronic	5.0 µg/L	
	Agriculture		
	Livestock	50 µg/L	
	Irrigation	20 µg/L	
	Public health food		
	Procurement	6,800 µg/L	
	Domestic water supply	50 µg/L	
Kentucky	Domestic water supply use—maximum allowable instream concentration	0.05 mg/L	BNA 2001
	MCL	0.05 mg/L	BNA 2001
	Maximum groundwater contaminant level	0.01 mg/L	BNA 2001
	Primary drinking water standard	0.01 mg/L	BNA 2001
	Warm water aquatic habitat criteria		BNA 2001
	Acute	20 µg/L	
	Chronic	5.0 µg/L	
Louisiana	Groundwater protection—MCL	0.01 mg/L	BNA 2001
Maine	Drinking water guideline	10 µg/L	HSDB 2001

8. REGULATIONS AND ADVISORIES

Table 8-1. Regulations and Guidelines Applicable to Selenium (*continued*)

Agency	Description	Information	References
<u>STATE (cont.)</u>			
Maryland	Criteria for toxic substances in surface waters		BNA 2001
	Freshwater		
	Acute	20 µg/L	
	Chronic	5.0 µg/L	
	Saltwater		
	Acute	300 µg/L	
	Chronic	71 µg/L	
	Drinking water	50 µg/L	
	MCL	0.05 mg/L	BNA 2001
	Primary drinking water standard	0.01 mg/L	BNA 2001
Massachusetts	Environmental toxicity values		BNA 2001
	Freshwater	20 µg/L	
	Acute	5.0 µg/L	
	Chronic		
	Marine		
	Acute	300 µg/L	
	Chronic	71 µg/L	
	Groundwater protection—MCL	0.01 mg/L	BNA 2001
	MCL	0.05 mg/L	BNA 2001
Michigan	MCL	0.05 mg/L	BNA 2001
	Effective date	07/30/92	
Minnesota	Drinking water guideline	30 µg/L	HSDB 2001
Mississippi	Groundwater standard	50 ppb	BNA 2001
	Water quality criteria—concentration shall not exceed	0.01 mg/L	BNA 2001
Montana	MCL	0.05 mg/L	BNA 2001
North Carolina	Fresh surface water quality standard for Class C waters	5.0 ug/L	BNA 2001
	Groundwater quality standard	0.05 mg/L	BNA 2001
Nebraska	Aquatic life		BNA 2001
	Acute	20 µg/L	
	Chronic	5.0 µg/L	
	Water supply	0.05 mg/L	BNA 2001
	MCL	0.05 mg/L	BNA 2001
New Hampshire	Groundwater quality standard	0.05 mg/L	

8. REGULATIONS AND ADVISORIES

Table 8-1. Regulations and Guidelines Applicable to Selenium (*continued*)

Agency	Description	Information	References
<u>STATE</u> (<i>cont.</i>)			
New Hampshire	MCLG	0.05 mg/L	BNA 2001
	MCL	0.05 mg/L	
	Water quality criteria		BNA 2001
	Protection of aquatic life		
	Fresh		
	acute	5.0 µg/L	
	chronic	290µg/L	
	Marine		
	acute	71 µg/L	
	chronic	170 µg/L	
	Protection of human health		
	Water and fish ingestion	11,000 µg/L	
New Mexico	MCL	0.05 mg/L	BNA 2001
Nevada	Domestic water supply		BNA 2001
	Dissolved selenium	0.05 mg/L	
New York	MCL	0.05 mg/L	BNA 2001
North Dakota	MCL	0.05 mg/L	BNA 2001
Ohio	Groundwater concentration limit	0.01 mg/L	BNA 2001
Oklahoma	Public and private water supplies	0.01 mg/L	BNA 2001
	Fish and wildlife propagation		BNA 2001
	Acute	20 µg/L	
	Chronic	5.0 µg/L	
Rhode Island	Groundwater quality standard	0.05 mg/L	BNA 2001
	Preventive action limit	0.025 mg/L	
South Carolina	MCL	0.05 mg/L	BNA 2001
South Dakota	Groundwater maximum allowable concentration	0.05 mg/L	BNA 2001
	Aquatic life value		BNA 2001
	Acute	20 µg/L	
	Chronic	5.0 µg/L	
Tennessee	Groundwater criteria concentration	0.05 mg/L	BNA 2001
	MCL	0.05 mg/L	BNA 2001
Texas	MCL	0.05 mg/L	BNA 2001
Utah	MCL	0.05 mg/L	BNA 2001
	Water quality		BNA 2001
	Domestic	0.01 mg/L	
	Agriculture	0.05 mg/L	

8. REGULATIONS AND ADVISORIES

Table 8-1. Regulations and Guidelines Applicable to Selenium (*continued*)

Agency	Description	Information	References
<u>STATE (cont.)</u>			
Vermont	Groundwater quality standards		BNA 2001
	Enforcement standard	50 µg/L	
	Preventive action level	25 µg/L	
	MCLG	0.05 mg/L	BNA 2001
	MCL	0.05 mg/L	
	Water quality criteria for protection of aquatic organisms		BNA 2001
	Maximum allowable concentration		
	Acute	20 µg/L	
	Average allowable concentration		
Virginia	Chronic	5.0 µg/L	
	Groundwater protection levels		BNA 2001
	Protection level	10 µg/L	
	Monitoring level	5.0 µg/L	
	MCL	0.01 mg/L	BNA 2001
	Surface water criteria		BNA 2001
	Freshwater		
	Acute	20 µg/L	
	Chronic	5.0 µg/L	
	Saltwater		
	Acute	300 µg/L	
	Chronic	71 µg/L	
Human health	Public water supplies	170 µg/L	
	All other surface waters	11,000 µg/L	
Washington	MCL	0.05 mg/L	BNA 2001
Wisconsin	Groundwater quality standards		BNA 2001
	Enforcement standard	50 µg/L	
	Preventive action limit	10 µg/L	
	MCL	0.05 mg/L	BNA 2001
Wyoming	Water quality		BNA 2001
	Aquatic life		
	Acute	20 µg/L	
	Chronic	5.0 µg/L	
Human health		10 µg/L	
c. Food			
New York	Bottled water sampling requirements—MCL	0.01 mg/L	BNA 2001

8. REGULATIONS AND ADVISORIES

Table 8-1. Regulations and Guidelines Applicable to Selenium (*continued*)

Agency	Description	Information	References
<u>STATE (cont.)</u>			
d. Other			
Alabama	Identification and listing of hazardous waste		BNA 2001
Arizona	Soil remediation levels Residential Non-residential	380 mg/kg 8,500 mg/kg	BNA 2001
California	Hazardous waste injection restrictions—waste specific prohibitions Selenium and/or compounds	100 mg/L	EPA 2001s 40CFR148.12(b)(2)
	Known to cause cancer or reproductive toxicity—initial appearance of chemical on list Selenium sulfide	10/01/89	BNA 2001
	Total threshold limit concentration	10,000 mg/kg	BNA 2001
Delaware	Regulated toxic substance—sufficient quantity Selenium hexafluoride	900 pounds/hour	BNA 2001
Florida	Toxic substance in the workplace Hydrogen selenium Selenium Selenium hexafluoride Selenium oxychloride Selenium sulfide		BNA 2001
Hawaii	Restricted use pesticides Selenium compounds	All concentrations	BNA 2001
Kentucky	Threshold planning quantity Hydrogen selenide Selenious acid Selenium oxychloride	10 pounds 1,000/10,000 pounds 500 pounds	BNA 2001
Massachusetts	Oil and hazardous material Selenious acid Selenium and compounds Selenium dioxide Selenium disulfide Selenium oxide Selenium oxychloride Selenium sulfide Selenourea		BNA 2001
Minnesota	RfD Health risk limit	0.005 mg/kg/day 30 µg/L	BNA 2001
New Hampshire	Restricted use pesticide	All concentrations	BNA 2001

8. REGULATIONS AND ADVISORIES

Table 8-1. Regulations and Guidelines Applicable to Selenium (*continued*)

Agency	Description	Information	References
<u>STATE (cont.)</u>			
New Jersey	Extraordinary hazardous substance—threshold quantity Selenium hexafluoride	700 pounds	BNA 2001
Oregon	Toxic substance—de minimis concentration	1.0 percent	BNA 2001
Vermont	Restricted use pesticide Selenium and compounds	All concentrations	BNA 2001

^aGroup 3: not classifiable as to its carcinogenicity to humans

^bGroup D: not classifiable as to its carcinogenicity to humans

^cGroup B2: probable human carcinogen

^dMonthly average concentrations

^eConversion factors are based on a hardness of 100 mg/L as calcium carbonate

ACGIH = American Conference of Governmental Industrial Hygienists; BNA = Bureau of National Affairs; CFR = Code of Federal Regulations; DWEL = drinking water equivalent level; EPA = Environmental Protection Agency; FDA = Food and Drug Administration; HAP = hazardous air pollutant; IARC = International Agency for Research on Cancer; IDLH = immediately dangerous to life and health; IRIS = Integrated Risk Information System; MCL = maximum contaminant level; MCLG = maximum contaminant level goal; NIOSH = National Institute for Occupational Safety and Health; OEL = occupational exposure limit; OSHA = Occupational Safety and Health Administration; PEL = permissible exposure limit; PQL = practical quantitation limit; RDA = recommended daily allowance; REL = recommended exposure limit; RfD = reference dose; TLV = threshold limit value; TWA = time-weighted average; WHO = World Health Organization